Pacific Invasive Species
Battler Series

USE ANTICOAGULANT RODENT BAIT SAFELY

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PACIFIC INVASIVES LEARNING NETWORK
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Our vision: A resilient Pacific environment sustaining our livelihoods and natural heritage in harmony with our cultures

Cover photo: Island Conservation

TABLE OF CONTENTS

Dear Invasive Species Battler,

We are a diverse bunch of people in the Pacific region, which spans a third of the earth's surface and encompasses about half of the global sea surface. We have ~2,000 different languages and ~30,000 islands. Pacific ecosystems are one of the world's biodiversity hotspots, with a large number of species found only in the Pacific and nowhere else. In fact, there are 2,189 single-country endemic species recorded to date. Of these species, 5.8 per cent are already extinct or exist only in captivity. A further 45 per cent are at risk of extinction. We face some of the highest extinction rates in the world.

The largest cause of extinction of single-country endemic species in the Pacific is the impact of invasive species. Invasives also severely impact our economies, ability to trade, sustainable development, health, ecosystem services, and the resilience of our ecosystems to respond to natural disasters. Fortunately, we can do something about it.

Even in our diverse region, we share many things in common. We are island people, we are self-reliant, and we rely heavily on our environment to support our livelihoods. We also share many common invasive species issues as we are ultimately connected. Sharing what we learn regionally benefits us and our families economically, culturally, and in our daily lives. The "Invasive Species Battler" series has been developed to share what we have learned about common invasive species issues in the region, with information and case studies that can assist you to make a decision about what to do next or where to go for further information.

The SPREP Invasive Species Programme aims to provide technical, institutional, and financial support to regional invasive species programmes in coordination with other regional bodies. We coordinate the Pacific Invasive Learning Network (PILN), a network of practitioners battling invasive species, and the Pacific Invasives Partnership (PIP), the umbrella regional coordinating body for agencies working on invasive species in more than one Pacific country.

For knowledge resources, outreach tools, and more information on SPREP, the Invasive Species Programme, PILN, and PIP, please visit the SPREP website: www.sprep.org

Thank you for your efforts,
SPREP Invasive Species Team

About this Guide

Anticoagulant rodenticides are an important tool for managing rodents by increasing the chances of success and lowering the resources required. This guide was developed to assist non-specialists in gaining a better understanding of the risks, costs, and benefits of using anticoagulant rodenticides. Everyone has a role to play in ensuring that rodenticides are used responsibly and that the risk of negative impacts to people and the environment is minimised. Failure to do so could result in the loss of support for the use of these useful tools.

SPREP thanks our partner Island Conservation for drafting this guideline following the completion of successful eradication projects in the Pacific region.

ISLAND CONSERVATION
Preventing Extinctions

How do anticoagulants work?

Anticoagulants are a class of drugs or toxicants that work to prevent coagulation of the blood. They do this by interfering with the synthesis of vitamin K-dependent clotting factors, which increases the blood's clotting time. If consumed, anticoagulants are absorbed through the gastrointestinal tract, but most can also be absorbed through the skin.

Warfarin was the first anticoagulant rodenticide to be discovered. It was found in mouldy sweet clover that had affected a herd of cattle. It was widely used until it was discovered that rodents were becoming resistant .

A number of new anticoagulants known as first- or second-generation have since been developed. Examples of first-generation anticoagulant rodenticides include warfarin, chlorophacinone, pindone, and diphacinone.

Did you know?

Anticoagulants in high-enough doses are toxic to all vertebrates, including people.

Second-generation anticoagulants include brodifacoum, bromadialone flocoumafen, and difethialone. The specific rodenticide will be found listed under the active ingredient on the packaging containing rodent bait.

How are anticoagulants used for rodent control and eradication?

Anticoagulants added to cereal baits have been used successfully to remove rodents and other invasive vertebrates from more than 400 islands worldwide, with significant benefits to biodiversity and human livelihoods. Anticoagulants are particularly effective against rodents because anticoagulants are slow acting, which reduces the risk of bait shyness. If rodent bait is placed into every rodent territory on an island and a sufficient quantity is made available to each individual within the population, then a rodent eradication project has a high chance of success.

First-generation anticoagulant rodenticides generally require that an animal eat multiple doses of the bait over several days. Second-generation anticoagulants are more toxic, and a lethal dose can rapidly be consumed in a short period.

For on-going rodent control projects, where long-term suppression of the rodent population is the aim rather than eradication, rodent bait is most often deployed in bait stations. For eradication projects, bait stations can be used or bait can be broadcast by hand or by using a helicopter. Bait stations generally present a lower risk to human health and the environment. Broadcast projects may present a greater risk to non-target species, but have a higher success rate and can be used on larger islands or islands where the use of bait stations would not be feasible.

The use of anticoagulant rodenticides over a prolonged period has led to resistance within some rodent populations and is a risk that must be taken into account when planning a rodent control or eradication project.

Where do I start for rat control or eradication using anticoagulants?


Photo: Island Conservation

Before you begin, it is important to take few things into account. You can eliminate or minimise many of the hazards associated with anticoagulant rodenticides by ensuring you are using the right approach.

For example, bait stations are an effective mechanism for dispensing bait on islands where good access to all parts of the island is possible. If second-generation anticoagulants are used for on-going rodent control projects, they must be managed carefully to minimise the quantity put into the environment and to reduce impacts on non-target animals because of the risk that the anticoagulants will accumulate in the environment.

Feasibility Assessment

When considering eradicating rodents on an island, you should assess the project feasibility. The feasibility assessment should determine if the project is a high priority as well as answer each of the following questions:

1. Can the technique(s) be used at the project site to remove all individuals within the target populations?
2. Can you prevent re-invasion of the target species and invasions from new invasive species?
3. What are the risks to human health and safety, non-target native species, and the environment? Are these risks acceptable, or can they be avoided, minimised, or mitigated?
4. Does the project have the support of the community and other key stakeholders?
5. Will you be able to secure all required permits and consents?
6. Do you have or can you acquire all the required skilled people, resources, and equipment necessary to complete the project?
7. Can you secure the necessary funding for the project?

If in doubt about where to start, contact an agency or organisation that you know has experience in the removal of rodents from islands for advice. If it is a small island of approximately 15 hectares or less, you can start by reading the Battler guide "Remove rodents from small tropical islands with success".

Operational Planning

In your feasibility assessment, you will have determined the best operational approach. This approach will be the one that maximises the chance of project success but for which the risks are acceptable and have the support of all key stakeholders.

It is important now that you create a plan for the operation that outlines how the project will take place and how risks to people and the environment will be managed. Two components of the operational plan should be:

1. a health and safety plan that describes the measures that will be taken to eliminate, isolate or minimise risks to people; and

2. a non-target species mitigation plan that sets out how potential risks to non-target species and the environment will be eliminated, isolated, or minimised.

What are the key cautionary concerns?

Keeping People Safe

The risks to human health are very low in a well-planned and controlled operation. However, it is important that you focus on keeping people safe. Thinking and operating with safety in mind will ensure that this tool is supported and remains available for future rodent eradications.

Identifying the Risks

Your health and safety plan should identify the pathways through which people could be exposed to the rodenticide. These pathways include:

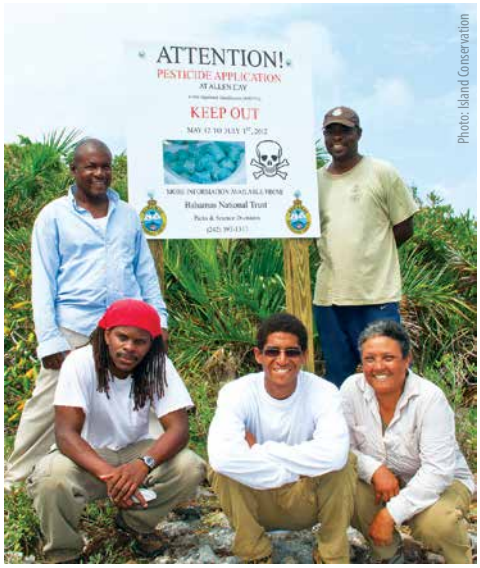
- **Ingestion of bait:** Young children could mistakenly eat bait if allowed access to it;
- **Skin exposure:** Staff involved in the project will be most at risk from this pathway. Most anticoagulants are also a slight skin and eye irritant;
- **Inhalation:** Inhalation of dust is possible when handling baits, opening bags, or handling bait under helicopters; and
- **Secondary poisoning:** Eating domestic or wild animals that have consumed bait or other poisoned animals could result in exposure to the rodenticide.

How do I manage the risks?

Your plan should outline how the pathways will be addressed. You cannot eliminate all risk to human health, but you can isolate and minimise the risks so that little hazard exists. Examples of risks being isolated are physically restricting access to the project site or to where rodent bait is stored. Examples of risks being minimised are training the staff involved in the project and ensuring all project stakeholders are aware of the hazards.

There are things you can do to keep people safe when using rodenticides:

- Alert all key stakeholders and potential users of the project site to the use of rodenticides and the potential pathways for exposure.
- Make sure the project team has the requisite experience and understanding to undertake the project safely.
- Ensure all team members have read and have copies of the pesticide label and MSDS(material safety data sheet).
- Discuss potential hazards, spillage, and accident procedures before starting the work.
- Provide protective clothing and equipment for employees and make sure they use it. Lead by example.
- Ensure hand-washing facilities are available, e.g. soap, paper towels, clean water.
- Ensure protective clothing and equipment is removed and hands/arms/face thoroughly washed at the end of a task or before eating, drinking, smoking, or using the toilet.
- Ensure all equipment used to handle, dispense, or carry pesticides (e.g. bucket or hopper) is fit for purpose and free of defects (i.e. no damage that may lead to spill).
- Do not open bags or handle rodent bait in a poorly ventilated or confined area.
- Isolate supplies of drinking water from potential contamination. Reduce the risk of bait entering waterways and the marine environment as far as is possible without compromising the success of the project.
- Isolate all domestic animals, preferably by removing them from the project site.
- Bury the carcasses of all poisoned animals that are found. Carcasses can be sampled for residues if necessary. Place a temporary ban on the harvest of food items that could become contaminated on or near the project site. If using a second-generation anticoagulant, a six month minimum period is recommended for invertebrates, such as land crabs, and a longer period for vertebrates. Expert advice should be sought to define the most appropriate withholding period.
- If possible, restrict access to the project site to only project team members until bait has fully broken down. Place warning signs at points of entry to the site alerting people to the hazards. Ensure these signs are simple, can be easily understood, and have an image of the rodent bait used.



Warning signs must include:

- information on the poison used;
- how to recognise it – including a photograph of the bait is recommended;
- what visitors should do and NOT do;
- instructions in the local language; and
- contact details so that the public can contact the project team.

Apply bait in bait stations if feasible and recover uneaten bait at the conclusion of the project. Unused bait and contaminated packaging and equipment should be sealed in clearly labelled containers that identify contents and taken to a disposal facility approved by a local authority, or, where transport to a disposal facility is impractical/unsafe. Follow the manufacturer's recommendations on the bait label (see page 11) regarding disposal.

Pesticide packaging should not be re-used for any other purpose.

How do I protect the environment while using rodenticides?

Identify impacts on the environment

Some anticoagulants can persist in the environment for a significant period of time, and rodent bait and the carcasses of poisoned animals can remain toxic for many months. As baits and carcasses degrade, anticoagulants are absorbed into the soil where they are then slowly degraded over weeks to months. Rainfall, soil type, temperature, and the presence of soil micro-organisms capable of degrading anticoagulants all influence degradation time.

Residues of anticoagulants have been recorded in both sub-lethally and lethally poisoned animals. Second-generation anticoagulants such as brodifacoum are not readily metabolised and are stored in the liver of sub-lethally exposed animals, where they can remain for many months. However, residues do not appear to persist in invertebrates, such as crabs and insects, beyond a few weeks.

Anticoagulants used in rodent baits have a low solubility in water, so water contamination, although possible, is unlikely. The low solubility of anticoagulants in water also means that uptake by plants is unlikely to occur.

Photo: Fa'ata Togia, National Park Service, Wiki Commons

Identify the Risks to Non-target Species

The use of anticoagulant rodenticides to target rodents poses risks to non-target species. However, if these risks are appropriately considered and addressed, the long-term benefits of removing invasive rodents should far outweigh any short-term impacts on wildlife.

Your project feasibility assessment will include an environmental risk assessment that will have identified the pathways by which non-target wildlife could be exposed to the rodenticide. These pathways are likely to include:

Primary poisoning: Rodent bait has been designed to target rodents and to be less attractive to other species. However, it can still be eaten by some non-target wildlife, and a number of mammal, bird, reptile, and invertebrate species have been recorded consuming rodent bait.

Secondary poisoning: Non-target species can also be exposed as a result of eating other animals that have been lethally or sub-lethally exposed to rodent bait.

Photo : Rainer Burkard, Wiki Commons

Manage the Risks to Non-target Species

An environmental risk assessment will evaluate the likelihood that adverse environmental effects may occur as a result of exposure to anticoagulants. The aim of your project should be to have the lowest possible impact on the environment and on non-target species.

The operation should be conducted at a time of year that maximises the chance of success but also minimises risk to non-target species. If necessary, you can directly mitigate risks for at-risk native species that are threatened at the population level. This mitigation could include captive management, translocation, hazing, Vitamin K treatment, etc.

The way this will be done should be the subject of your operational plan or non-target species mitigation plan. You will not be able to eliminate all risk, but you may be able to isolate or minimise key risks. An example of isolating a risk would be to place a species into captivity during the period over which exposure is possible. An example of risk minimisation might be undertaking a project at the time of the year when a vulnerable species is at its lowest abundance.

What safety gear do we need?

It is important to use safety gear or personal protective equipment (PPE) for staff implementing the project. Following is a guide on gear to be used in certain situations.

Handling unopened packages

Protective clothing and footwear should be worn along with gloves.

Handling rodent bait

Protective clothing and footwear should be worn along with gloves. A dust mask and goggles is also recommended especially if exposure to dust is possible.

Working under a helicopter

As for handling rodent bait, protective clothing and footwear should be worn along with gloves. A half-face respirator is required instead of a dust mask because of the high inhalation risk. A hard hat along with goggles should be worn because of risk of head injury.

Clean up and disposal

When cleaning contaminated equipment and PPE, wear an apron in addition to other protective clothing, footwear, goggles, and gloves to protect yourself and your staff from splashes.

Contaminated safety equipment, machinery, and any other equipment that has been in contact with rodent bait should be thoroughly washed at a location where runoff is unlikely to enter any natural water way.

Follow the manufacturer's instructions for use and maintenance of personal protective equipment.

How do I store and dispose of rodent bait?

Secure storage and appropriate disposal of rodent bait will remove many of the potential risks posed by your project. This section provides guidelines for these activities.

Secure Storage

Unless being used, rodent bait should be stored in a locked and animal-proof facility. The bait should be accessible only to you and other members of the project team.

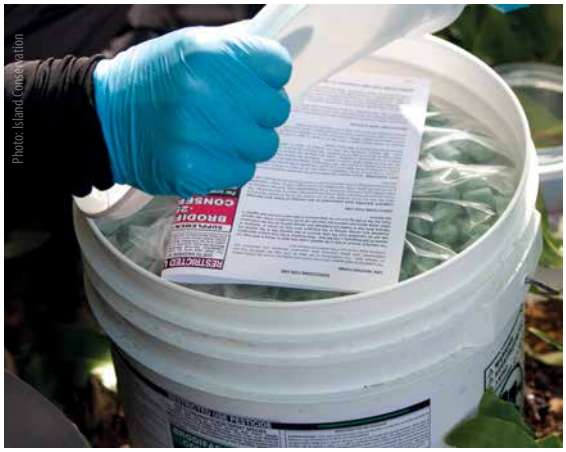
If bait is to be stored in one place for a reasonable period of time, make sure that place is dry, has good air flow, and excludes rodents. Unless in buckets, bait should be stored off the ground (e.g. on pallets).

Even if bait is properly stored, over time it will become less palatable to rodents. Rodents are less likely to consume stale bait, so it is important to ensure bait stays as fresh as possible.

Safe Disposal

The best and safest option for disposing of rodent bait and contaminated packaging and equipment is to seal them in clearly labelled containers that identify the contents and to take them to a disposal facility approved by a local authority where they can be disposed of safely.

If it is not possible to transport unused or recovered bait, then burying or burning rodent bait are options recommended by some manufacturers. If bait is buried, it should be buried within the biologically active layer of soil within a secure area. If bait is to be burned, it should be disposed of in a suitably constructed and appropriately located incinerator and any residues buried as above. Because the smoke and fumes produced by burning are irritating and potentially harmful, ensure the wind does not carry the smoke plume toward populated areas.



What about emergencies?

Even the best-planned project can have an emergency. It is important to make sure that you know what to do in the event that one occurs.

Be Aware of the Risks and Hazards

You should read and follow the instructions on the product label and the Material Safety Data Sheet (MSDS). The label and MSDS will give you important information about first aid and what to do if there is a spill.

Prepare for an Emergency

You should be prepared for an emergency regardless of the amount or type of rodent bait you have.

- you and your staff have planned for and know what to do in an emergency.
- you have product labels and an MSDS available.
- rodent bait is in labelled containers, and the label stays readable and on the container.

Depending on the type and the amount of rodent bait you need and the method of transport and application, an emergency response plan may be warranted. The emergency response plan should have clearly documented procedures to deal with all reasonably likely emergencies, including spills or poisoning.

The plan should include details of:

- who to contact and warn in an emergency, such as emergency services and people at and near to the project site;
- who is responsible for the plan and what they will do; and
- how decisions are made about what to do and in what order.

Vitamin K is an effective antidote to anticoagulant poisoning. However, treatment over an extended period may be required. Seek guidance from a medical professional.

Photo : SPREP

For More Information

The Battler Resource Base contains information materials and resources for battling invasive species: www.sprep.org/piln/resource-base.

You can contact the Invasive Species Programme through the SPREP website: www.sprep.org/Invasive-Species/bem-invasive-species.

More information is available from the following sources:

Island Conservation www.islandconservation.org

New Zealand Department of Conservation www.doc.govt.nz

Pacific Invasives Initiative www.pacificinvasivesinitiative.org
Pacific Rat/Cat eradication kit

European Biocidal Products Forum. Guideline on best practice in the use of rodenticide baits as biocides in the European Union.

Join the Fight

Protect our islands from invasive species